

1       Claims

2                    1.       A method of making a hollow plastic part by a thermoforming process  
3       including:  
4                    continuously extruding a multiple layer sheet onto a shear support and cutting said  
5       extruded sheet into discrete lengths while said sheet is being extruded;  
6                    immediately loading in pairs of successively cut sheets one at a time side by side  
7       onto a sheet transfer car and transferring said car with said loaded pair of sheets into an oven and  
8       heating said sheets therein to a proper temperature for thermoforming;  
9                    transferring said transfer car and heated sheets into a forming station and  
10       thermoforming respective pieces of said part from each sheet in cavities in molds in said forming  
11       station;  
12                    thereafter forcing said molds with said formed sheets together to fuse said pieces  
13       together into a completed part; and  
14                    thereafter separating said molds and removing said completed part.

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16                    2.       The method according to claim 1 wherein sheets are loaded into said  
17       transfer car by a pair of shuttles each alternately receiving a successive cut sheet, each shuttle  
18       shifted to be aligned with a respective one of a pair of sheet supports and conveying said sheets  
19       onto a respective support, and positioning a respective one of two clamping frames on said  
20       transfer car around a respective cut sheet on a support and clamping the same into said respective  
21       clamping frame.

1                   3.       The method according to claim 2 wherein said transfer car is positioned  
2       above said pair of supports as a cut sheet is deposited on each support, and said transfer car is  
3       thereafter lowered to enclose said sheets in respective clamping frames.

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5                   4.       The method according to claim 3 wherein said transfer car is elevated to  
6       clear said supports after said sheets are clamped in to a respective clamping frame and thereafter  
7       moved into said oven.

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9                   5.       The method according to claim 2 wherein successive transfer cars are  
10      loaded with pairs of sheets by said shuttles, said successive transfer cars thereafter occupying  
11      said oven and said forming station respectively.

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13                  6.       The method according to claim 1 wherein said cut sheets are deposited  
14      onto said support at least in part by conveying said cut sheets onto said supports.

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16                  7.       The method according to claim 2 wherein said cut sheets are moved onto  
17      each of said shuttles by a conveyor on each of said shuttles.

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19                  8.       The method according to claim 1 wherein each of said molds is mounted  
20      on a platen, said molds are initially each positioned with a cavity facing upward and said heated  
21      sheets are lowered by said transfer car onto a respective mold cavity and thereafter thermoformed  
22      into said cavity.

1                   9.     The method according to claim 8 wherein said molds are pivoted to move  
2     said mold cavities into facing positions and are thereafter brought together to fuse said pieces  
3     together.

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5                   10.    The method according to claim 9 wherein said molds are locked together  
6     and thereafter squeezed together by hydraulic cylinders to fuse said molded sheets together.

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8                   11.    The method according to claim 9 wherein two sets of molds are alternately  
9     positioned to receive a pair of sheets to be thermoformed while the other set remains forced  
10    together to cool said part prior to separating said molds.

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12                  12.    The method according to claim 1 wherein said shear support is cooled to  
13    cool said extruded sheet.

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15                  13.    The method according to claim 12 wherein said sheet is conveyed onto  
16    said shear support.

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18                  14.    The method according to claim 8 wherein a pair of mold plugs are lowered  
19    as said sheets are lowered onto said mold cavities and are thereafter extended to be engaged with  
20    said sheets to assist said thermoforming thereof.

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22                  15.    The method according to claim 14 wherein said transfer car is lowered on

1 a support to bring said sheets over said mold cavities and said mold plugs are mounted to said  
2 support to be lowered therewith.

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4 16. The method according to claim 8 wherein said sheet transfer car is lowered  
5 to bring said heated sheets over said mold cavities.

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7 17. The method according to claim 16 wherein said transfer car releases said  
8 heated sheets after thermoforming thereof and is raised thereafter.

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10 18. The method according to claim 17 wherein an insert is placed in at least  
11 one of said cavities formed in said sheets after said transfer car is raised.

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13 19. The method according to claim 17 wherein said transfer car is raised above  
14 the top of said oven when being raised from said mold cavities and are thereafter transferred  
15 linearly back to a position over said supports preparatory to being loaded with another two cut  
16 sheets by said shuttles.

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18 20. A twin sheet thermoforming apparatus comprising:  
19 an extruder for continuously extruding a continuous plastic sheet;  
20 a moving shear cutting said extruded sheet into cut sheets while said sheet is being  
21 extruded;  
22 a pair of shuttles each receiving alternately sheets sheared from said extruded

1 sheet;

2 a series of transfer cars, each having a pair of clamping frames adapted to clamp a  
3 cut sheet therein;

4 a transfer system successively positioning each of said transfer cars over a pair of  
5 stationary cut sheet supports;

6 said shuttles each shifting from a position aligned with said shear to a position  
7 aligned with one of said sheet supports;

8 a conveyor for moving each cut sheet from an aligned shuttle onto a respective  
9 sheet support;

10 a lift/lower system lowering each transfer car to position a cut sheet on said sheet  
11 support within clamping frame thereon, said clamping frames including gripper clamps adapted  
12 to clamp to the edges of said cut sheet therein;

13 an oven for heating said cut sheets to a proper final temperature for  
14 thermoforming;

15 a transfer system for transferring each sheet transfer car into said oven after  
16 clamping a pair of sheets into said clamping frames;

17 said transfer system at the same time transferring another transfer car from said  
18 oven into a forming station;

19 said forming station including a set of side by side mold assemblies each  
20 including a mold having a mold cavity;

21 said mold assemblies each including positioning arrangement positioning said  
22 mold cavity facing towards said sheet transfer car loaded with said cut sheets;

1 a lift/lower system lowering said transfer car to position said cut sheets over a  
2 respective mold cavity;

3 said lift/lower system raising said transfer car after said sheets are released from  
4 said clamping frames;

5 said positioning arrangement reorienting said molds after said thermoforming  
6 apparatus has molded said sheets to a respective mold cavity so that said mold cavities and sheets  
7 therein are facing each other and moving said mold cavities and molded sheets thereon together  
8 to fuse said molded sheets together to form a hollow part;

9 said positioner arrangement thereafter separating said molds to allow removal of  
10 said hollow part.

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12 21. An apparatus according to claim 20 further including a second set of mold  
13 assemblies, each set alternately positioned beneath a transfer car loaded with cut sheets to  
14 alternately mold therein pairs of cut sheets.

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16 22. An apparatus according to claim 20 further including a return linear  
17 transfer system transferring each transfer car back over said oven to said position above said  
18 stationary cut sheet support.

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20 23. An apparatus according to claim 20 wherein each of said shear support,  
21 said shuttles and said cut sheet supports are comprised of powered roller conveyors.

1                   24.     An apparatus according to claim 20 further including a pair of mold plug  
2 assemblies carried down and up with said transfer car, said mold plug assemblies each including  
3 actuators for moving respective mold plugs into a respective sheet overlying a respective mold  
4 cavity.

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6                   25.     A twin sheet thermoformer apparatus having a forming station including a  
7 first set of rotatable mold assemblies each assembly including a mold having an exposed mold  
8 cavity; said mold of each assembly pivotally mounted above a platform to be rotatable between a  
9 position with said mold cavities facing up and a rotated position with said cavities facing each  
10 other, said mold assemblies each having actuators adapted to rotate said molds between said  
11 positions;

12                   said mold assemblies further mounted to be relatively movable linearly together  
13 and apart and an actuator arrangement for moving said molds together and apart to bring a  
14 molded sheet in each cavity into abutment to be fused together and then separated to allow  
15 removal of a completed part produced by said fusing together of said molded sheets.

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17                   26.     The apparatus according to claim 25 further including a second set of two  
18 mold assemblies each assembly including a mold having an exposed mold cavity; said mold of  
19 each assembly pivotally mounted above said platform to be rotatable from a position where said  
20 cavity is facing up to a position where said cavity of each mold is facing the cavity of the other  
21 mold;

22                   said mold assemblies including actuators to rotate said molds between said

positions, said mold assemblies being linearly movable on said platform together and apart from each other to bring said mold cavities together and apart and an actuator arrangement bringing a molded sheet in each cavity into abutment to be fused together and separating said molds to allow removal of a part produced by said fusing; and

a linear actuator shifting said platform sideways to allow said first and second set of mold assemblies to be alternately positioned beneath a lift/lower system positioning sheets to be molded on the mold cavities of the molds on one of said mold assemblies at a time.